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(54) **Recording sheets containing alcohols and saccharides.**

(57) A recording sheet which comprises a substrate and a material selected from the group consisting of monosaccharides, oligosaccharides, and mixtures thereof. Another embodiment of the present invention is directed to a printing process which comprises (a) providing a recording sheet which comprises a substrate, a material selected from the group consisting of monomeric alcohols, monosaccharides, oligosaccharides, and mixtures thereof, an optional binder, an optional antistatic agent, an optional biocide, and an optional filler; (b) applying an aqueous recording liquid to the recording sheet in an imagewise pattern; and (c) thereafter exposing the substrate to microwave radiation, thereby drying the recording liquid on the recording sheet.

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The present invention is directed to recording sheets, such as transparency materials, filled plastics, papers, and the like. More specifically, the present invention is directed to recording sheets particularly suitable for use in ink jet printing processes.

While known compositions and processes are suitable for their intended purposes, a need remains for improved recording sheets. In addition, there is a need for improved recording sheets suitable for use in ink jet printing processes. Further, a need remains for recording sheets which exhibit rapid drying times when imaged with aqueous inks. Additionally, there is a need for recording sheets which enable precipitation of a dye from a liquid ink onto the sheet surface during printing processes. A need also remains for recording sheets which are particularly suitable for use in printing processes wherein the recorded substrates are imaged with liquid inks and dried by exposure to microwave radiation. Further, there is a need for recording sheets coated with a discontinuous, porous film. There is also a need for recording sheets which, subsequent to being imaged with an aqueous ink, exhibit reduced curling.

It is an object of the present invention to provide recording sheets with the above noted advantages.

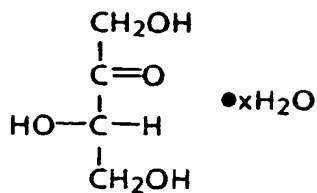
The present invention provides a recording sheet which comprises a substrate and a material selected from the group consisting of monosaccharides, oligosaccharides, and mixtures thereof. Another embodiment of the present invention is directed to a printing process which comprises (a) providing a recording sheet which comprises a substrate, a material selected from the group consisting of monomeric alcohols, monosaccharides, oligosaccharides, and mixtures thereof, an optional binder, an optional antistatic agent, an optional biocide, and an optional filler; (b) applying an aqueous recording liquid to the recording sheet in an imagewise pattern; and (c) thereafter exposing the substrate to microwave radiation, thereby drying the recording liquid on the recording sheet.

The recording sheets of the present invention comprise a substrate and at least one material selected from the group consisting of monomeric alcohols, monosaccharides, oligosaccharides, and mixtures thereof. Any suitable substrate can be employed. Examples include transparent materials, such as polyester, with polyester such as Mylar™ being preferred in view of its availability and relatively low cost. The substrate can also be opaque, including opaque plastics. Filled plastics can also be employed as the substrate, particularly when it is desired to make a "never-tear paper" recording sheet. Paper is also suitable, including plain papers such as Xerox® 4024, diazo papers, or the like.

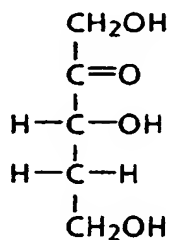
Examples of other suitable substrates are mentioned in U.S. application S.N. 08/196,922, a copy of which was filed with the present application.

The substrate can be of any effective thickness. Typical thicknesses for the substrate are from about 50 to about 500 μm, and preferably from about 100 to about 125 μm, although the thickness can be outside these ranges.

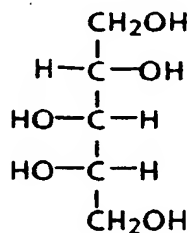
Situated on the substrate of the present invention is a material selected from the group consisting of monomeric alcohols, monosaccharides, oligosaccharides, and mixtures thereof. Monomeric alcohols generally are compounds in which a -OH group is attached to a carbon atom having attached thereto hydrogen atoms, other carbon atoms, and/or any functional groups other than a carbonyl (C=O) linkage, as a carbonyl group on the same carbon to which the -OH group is bound would render the compound a carboxylic acid. Examples of suitable alcohols include (1) aliphatic alcohols, such as (1) pentaerythritol  $C(CH_2OH)_4$  (Aldrich P475-5); (2) dipentaerythritol  $(HOCH_2)_3CCH_2OCH_2C(CH_2OH)_3$  (Aldrich D20, 320-3); (3) tripentaerythritol  $(HOCH_2)_3CCH_2OCH_2C(CH_2OH)_2CH_2OCH_2C(CH_2OH)_3$  (Aldrich 10,764-6); (4) 1,2,7,8-octane tetrol  $-[CH_2CH_2CH(OH)CH_2OH]_2$  (Aldrich 26,027-4); (5) D-erythrose  $HOCH_2[CH(OH)]_2CHO$  (Aldrich 12, 098-7); (6) threitol  $HOCH_2[CH(OH)]_2CH_2OH$  (Aldrich 26,355-9, Aldrich 29,887-5); (7) meso-erythritol  $HOCH_2[CH(OH)]_2CH_2OH$  (Aldrich E260-4); (8) xylitol  $HOCH_2[CH(OH)]_3CH_2OH$  (Aldrich 85,158-2); (9) trishydroxymethyl ethane  $H_3CC(CH_2OH)_3$  (Aldrich T8, 780-7); (10) choline hydroxide  $HOCH_2CH_2N(CH_3)_3OH$  (Aldrich 29,425-7; C7, 971-9); (11) tris (hydroxymethyl) amino methane  $(CH_2OH)_3CNH_2$  (Aldrich T8, 760-2); (12) tris (hydroxymethyl) nitro methane  $(CH_2OH)_3CNO_2$  (Aldrich 10, 818-9); (13) 2-ethyl-2-(hydroxymethyl)-1,3-propane diol  $C_2H_5C(CH_2OH)_3$  (Aldrich 23,974-7; 14,808-3); (14) (±)-pantothenol  $HOCH_2C(CH_3)_2CH(OH)CONH(CH_2)_3OH$  (Aldrich 29,578-7); (15) 1-[N,N-bis (2-hydroxyethyl) amino]-2-propanol  $CH_3CH(OH)CH_2N(CH_2CH_2OH)_2$  (Aldrich 23,375-7); (16) N,N,N',N'-tetrakis (2-hydroxypropyl) ethylene diamine  $[-CH_2CH(OH)CH_2]_2NCH_2CH_2N[CH_2CH(OH)CH_3]_2$  (Aldrich 12, 226-2); (17) N,N,N',N',N"-pentakis (2-hydroxypropyl) diethylene triamine  $CH_3CH(OH)CH_2N[CH_2CH_2N(CH_2CH(OH)CH_3)]_2$  (Aldrich 29,583-3); (18) (S)-(+)-erythrose hydrate [(S)-1, 3, 4-trihydroxy butanone hydrate] (Aldrich 32,985-1), of the formula:



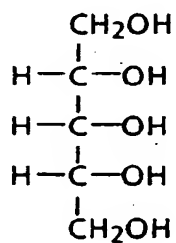
(19) L-xylulose (Aldrich 28,417-3), of the formula:



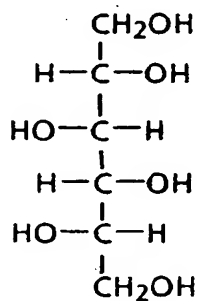
(20) L-arabitol (Aldrich 85,135-3), of the formula:



(21) adonitol (Aldrich 15,337-0), of the formula:



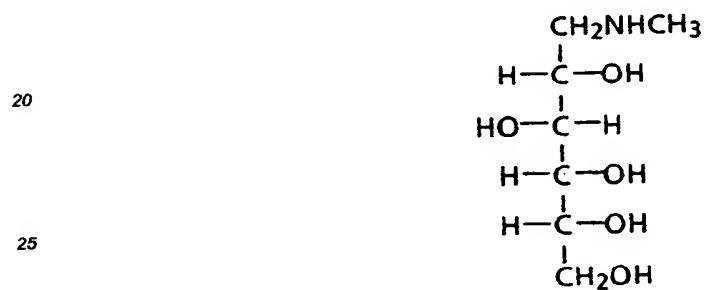
(22) L-iditol (Aldrich 30,227-9), of the formula:



(23) dulcitol (Aldrich D22,315-8), of the formula:



(24) n-methyl D-glucamine (Aldrich M4700-2), of the formula:



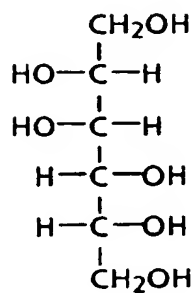
(25) D-gluconic acid (Aldrich G195-1), of the formula:



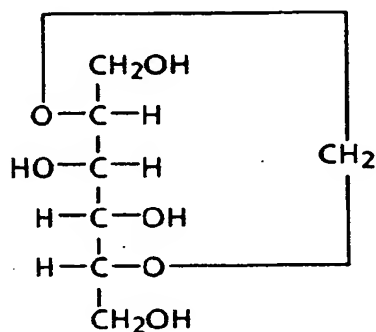
(26) D-sorbitol (Aldrich 5,375-5), of the formula:



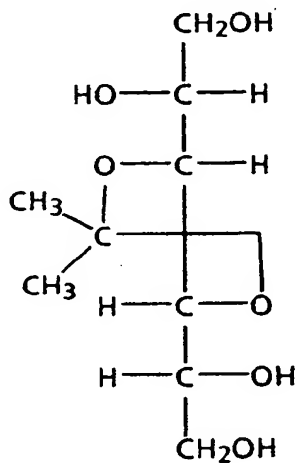
(27) D-mannitol (Aldrich M235-7), of the formula:



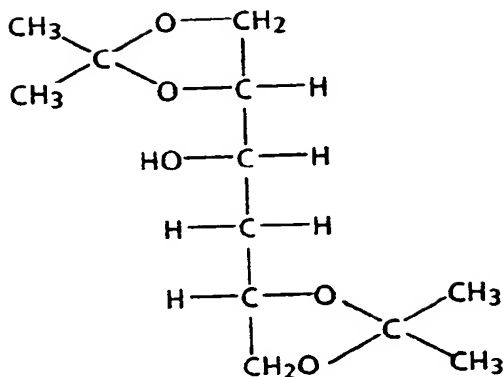
(28) 2,5-O-methylene-D-mannitol (Aldrich 20,665-2), of the formula:



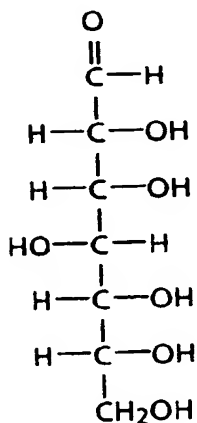
(29) 3,4-O-isopropylidene-D-mannitol (Aldrich 33,817-6), of the formula:



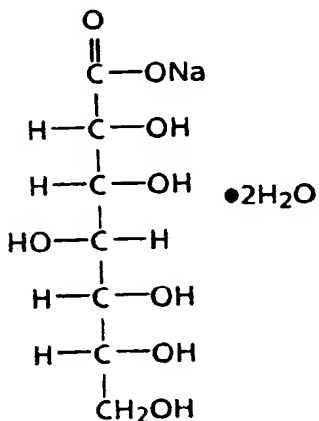
(30) 1,2,5,6-di-O-isopropylidene-D-mannitol (Aldrich 29,640-6), of the formula:



(31) D-glycero-D-gulo-heptose (Aldrich 20,668-7), of the formula:



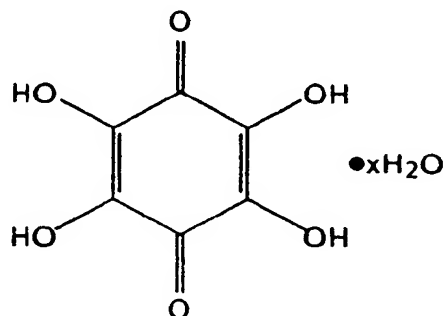
(32) D-glycero-D-gulo-heptonic acid, sodium dihydrate (Aldrich 30,676-2), of the formula:



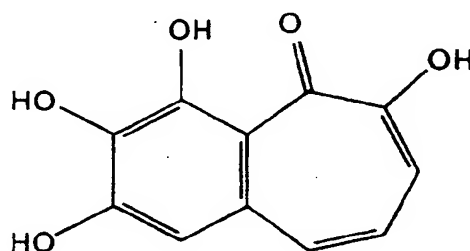
and the like.

Also suitable are (II) aromatic alcohols, such as (1) pyrogallol (also called 1,2,3-trihydroxybenzene)  $\text{C}_6\text{H}_3(\text{OH})_3$  (Aldrich 25,400-2); (2) phloroglucinol dihydrate (1,3,5-trihydroxy benzene dihydrate)  $\text{C}_6\text{H}_3(\text{OH})_3 \cdot 2\text{H}_2\text{O}$  (Aldrich P3, 800-5); (3) 1,1,1-trihydroxyphenyl ethane  $\text{CH}_3\text{C}(\text{C}_6\text{H}_4\text{OH})_3$  (Aldrich 32,684-4); (4) 2',3',4',-trihydroxyacetophenone  $(\text{HO})_3\text{C}_6\text{H}_2\text{COCH}_3$  (Aldrich T6, 440-8); (5) 2',4',6',-trihydroxyacetophenone monohydrate  $(\text{HO})_3\text{C}_6\text{H}_2\text{COCH}_3 \cdot \text{H}_2\text{O}$  (Aldrich T6,460-2); (6) 2,3,4-trihydroxybenzaldehyde  $(\text{HO})_3\text{C}_6\text{H}_2\text{CHO}$

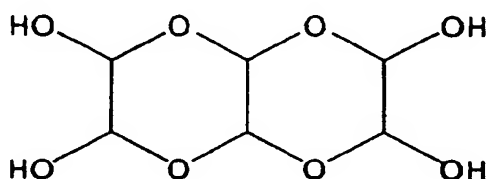
(Aldrich 26,084-3); (7) 2,4,6-trihydroxybenzaldehyde hydrate  $(\text{HO})_3\text{C}_6\text{H}_2\text{CHO}\cdot\text{H}_2\text{O}$  (Aldrich T6,540-4); (8) 3,4,5-trihydroxybenzaldehyde monohydrate  $(\text{HO})_3\text{C}_6\text{H}_2\text{CHO}\cdot\text{H}_2\text{O}$  (Aldrich 25,959-4); (9) 2,3,4-trihydroxy benzoic acid  $(\text{HO})_3\text{C}_6\text{H}_2\text{COOH}$  (Aldrich 25,384-7); (10) 2,4,6-trihydroxy benzoic acid monohydrate  $(\text{HO})_3\text{C}_6\text{H}_2\text{COOH}\cdot\text{H}_2\text{O}$  (Aldrich T6, 560-9); (11) 1,3,5 cyclohexane triol dihydrate  $\text{C}_6\text{H}_9(\text{OH})_3\cdot 2\text{H}_2\text{O}$  (Aldrich 35,901-7); (12) 1,3,4,5-tetrahydroxy cyclohexane carboxylic acid  $(\text{HO})_4\text{C}_6\text{H}_7\text{COOH}$  (Aldrich 13,862-2); (13) 2,2',4,4'-tetrahydroxybenzophenone  $[(\text{HO})_2\text{C}_6\text{H}_3]_2\text{CO}$  (Aldrich T1, 640-3); (14) tetrahydroxy-1,4-benzoquinone hydrate (Aldrich T1, 700-0), of the formula:



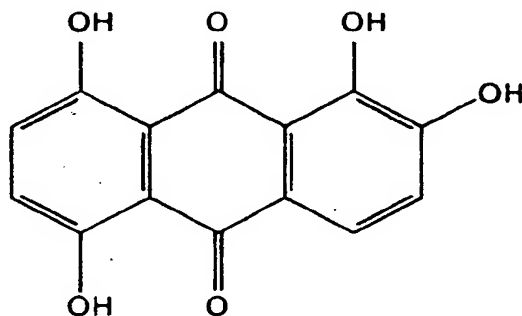
(15) purpurogallin (Aldrich P5, 590-2), of the formula:



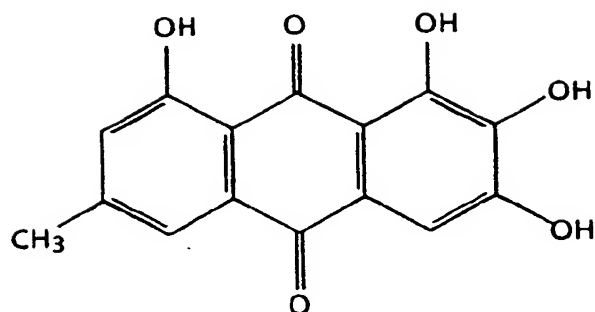
(16) glyoxal-trimeric dihydrate (Aldrich 22,013-2), of the formula:



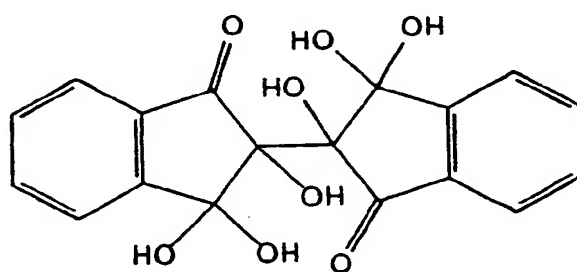
(17) quinalizarin (1,2,5,8-tetrahydroxy anthraquinone) (Aldrich 13,677-8), of the formula:



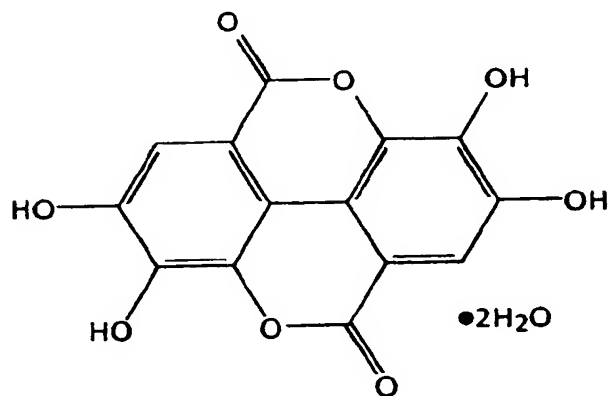
(18) emodin (Aldrich 23,051-0), of the formula:



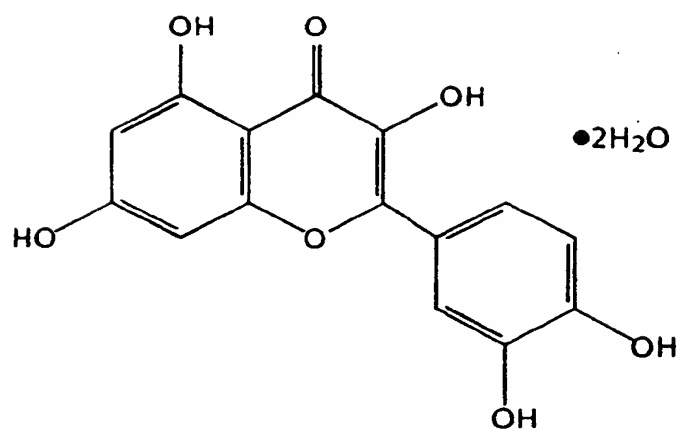
(19) hydrindantin dihydrate (Aldrich 13,563-1), of the formula:



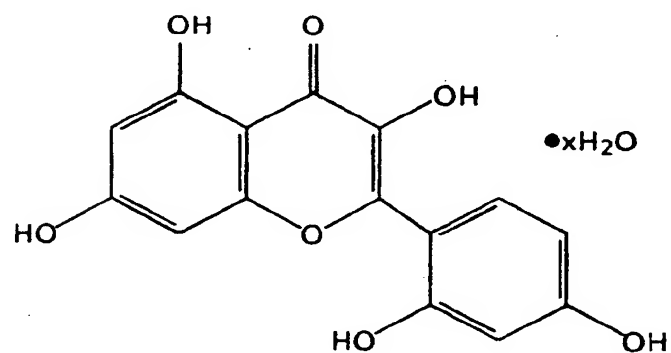
(20) ellagic acid dihydrate (Aldrich E40-1), of the formula:



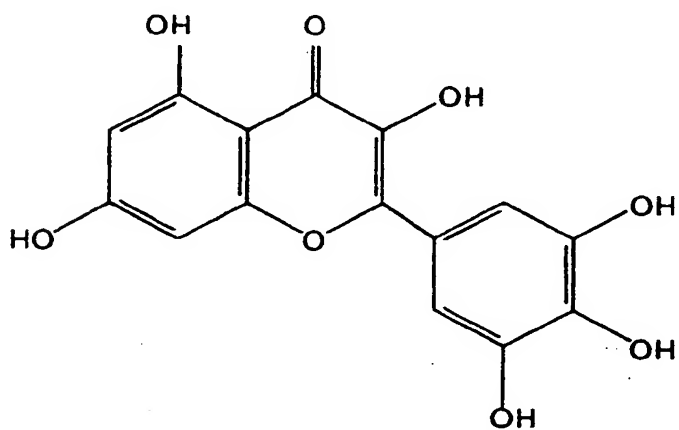
(21) quercetin dihydrate (3,3',4',5,7-pentahydroxy flavone dihydrate (Aldrich 17,196-4), of the formula:



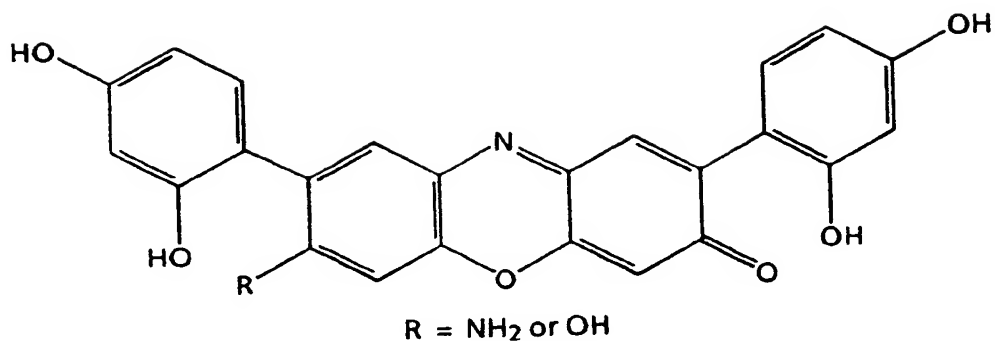
(22) morinhydrate (2',3,4,5,7-pentahydroxy flavone hydrate (Aldrich M8, 763-0), of the formula:



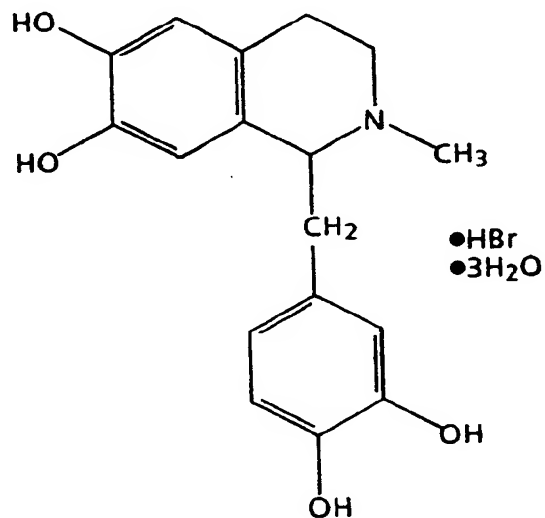
(23) myricetin (Aldrich 11,481-2), of the formula:



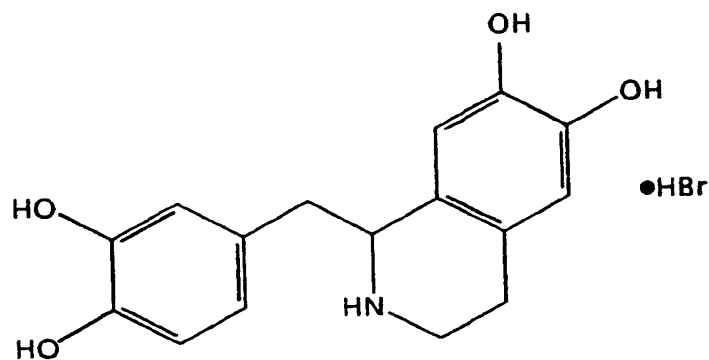
(24) lacmoid (Aldrich 27,472-0), of the formula:



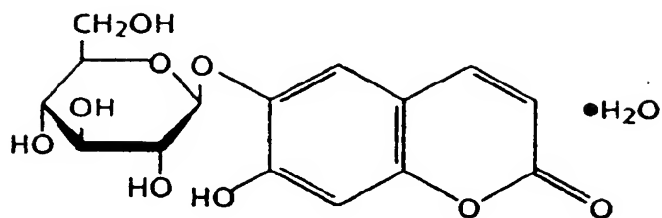
15 (25) D,L-laudanosoline hydrobromide trihydrate (Aldrich 11,577-0), of the formula:



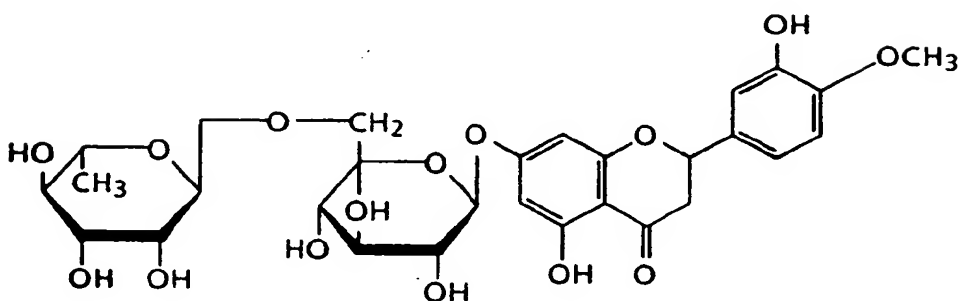
40 (26) tetrahydropapaveroline hydrobromide (Aldrich 24,215-2), of the formula:



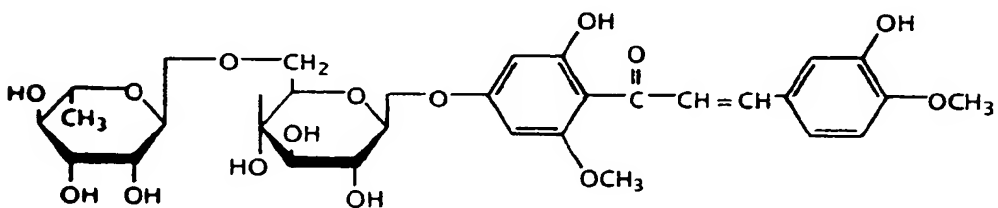
55 (27) esculin monohydrate (Aldrich E280-9), of the formula:



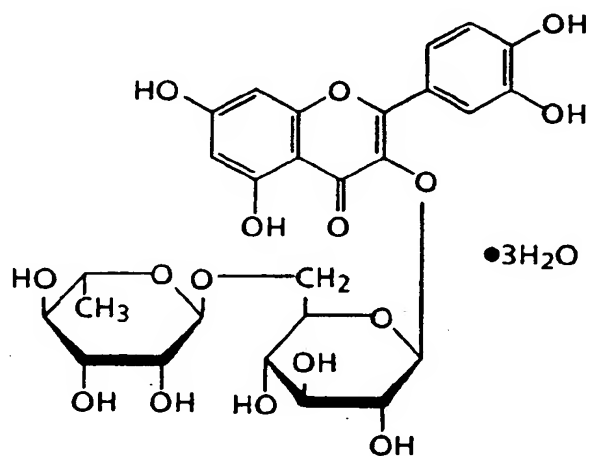
(28) hesperidin (Aldrich 29,260-5), of the formula:



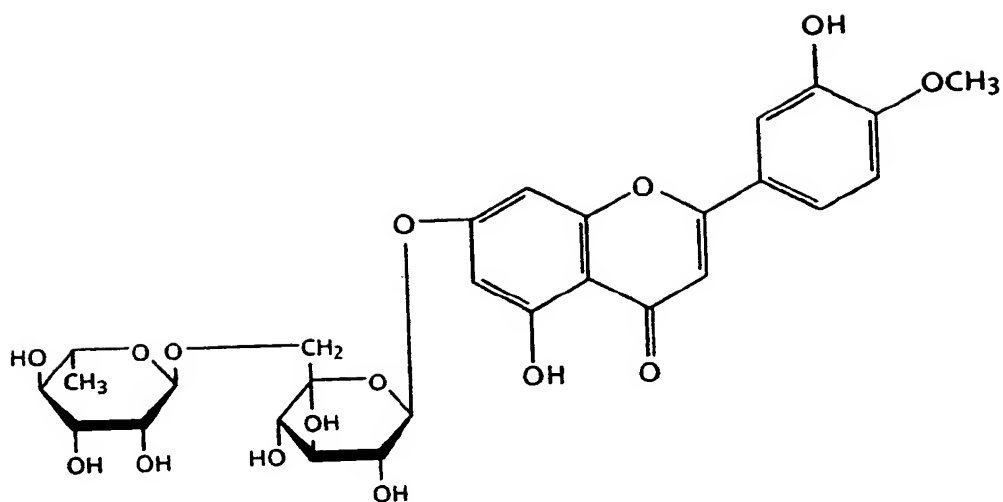
(29) hesperidin methyl chalcone (Aldrich H500-6), of the formula:



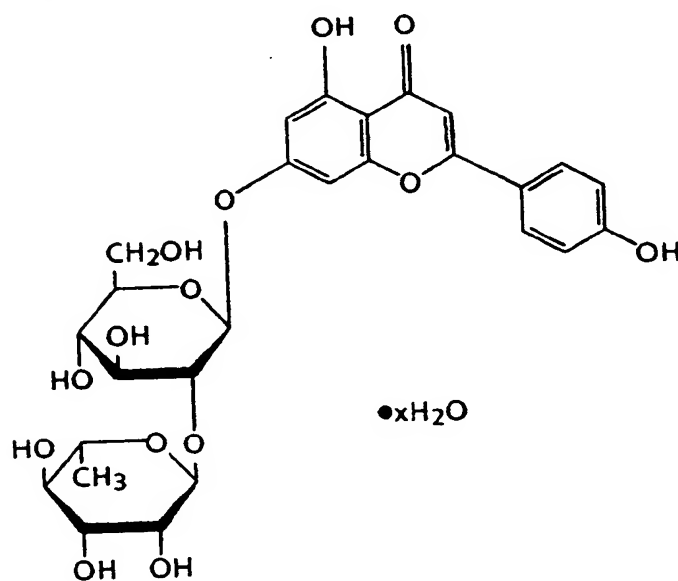
(30) (+)-rutin trihydrate (Aldrich R230-3), of the formula:



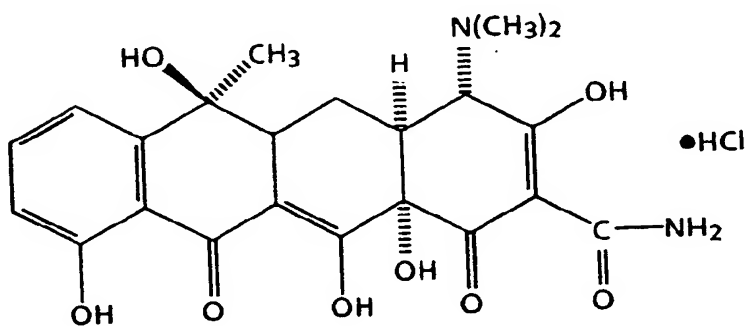
(31) 3',5,7-trihydroxy-4'-methoxyflavone-7-rutinoside (Aldrich 24,531-3), of the formula:



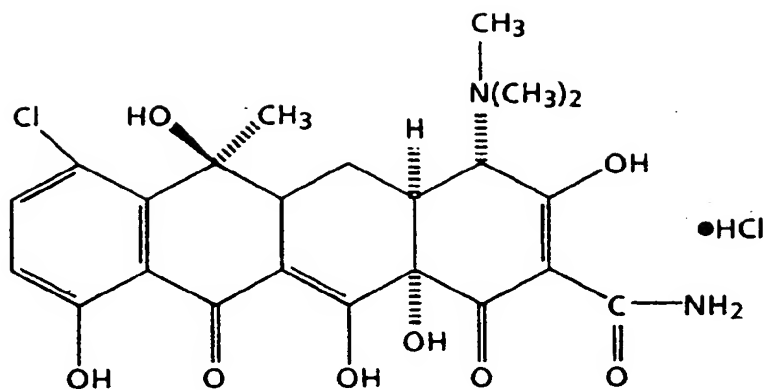
(32) naringin hydrate (Aldrich 22,249-6), of the formula:



(33) tetracycline hydrochloride (Aldrich 25,016-3), of the formula:

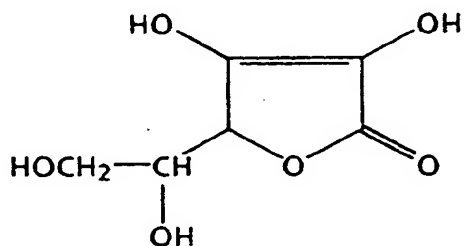


(34) chlorotetracycline hydrochloride (Aldrich 27,180-2), of the formula:

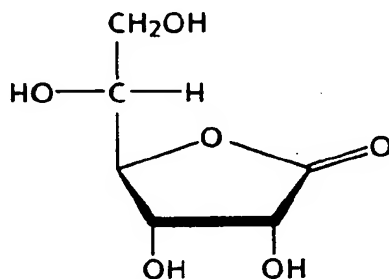


and the like.

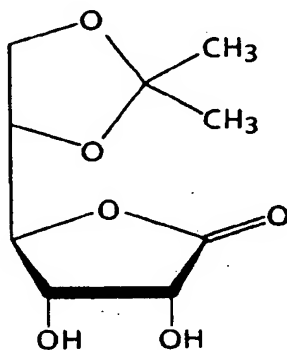
Also suitable are (III) heterocyclic alcohols, such as (1) L-ascorbic acid (Aldrich A9,290-2), of the formula:



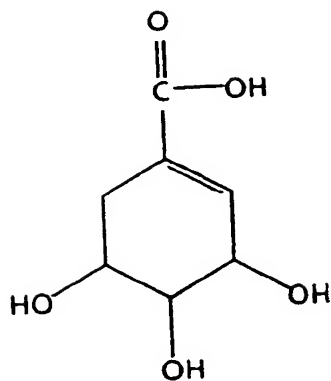
(2) D-isoascorbic acid (Aldrich 85,606-1), of the formula:



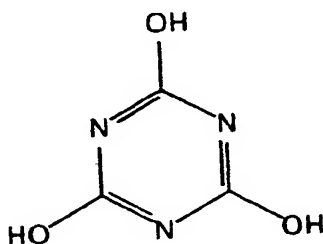
(3) 5,6-isopropylidene-L-ascorbic acid (Aldrich 30,136-1), of the formula:



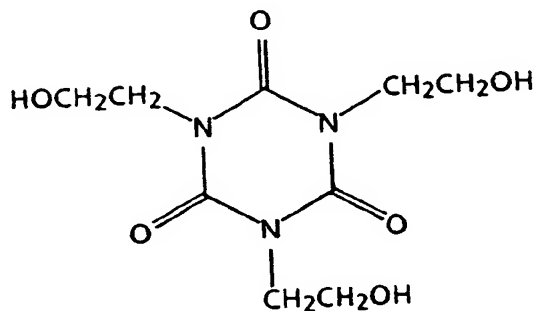
(4) shikimic acid (Aldrich S320-8), of the formula:



(5) cyanuric acid (Aldrich C9, 545-5), of the formula:

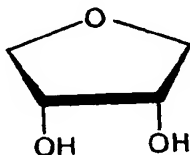


(6) 1,3,5-tris (2-hydroxyethyl) cyanuric acid (Aldrich 30,900-1), of the formula:

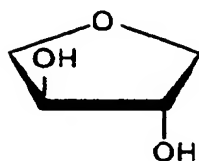


and the like.

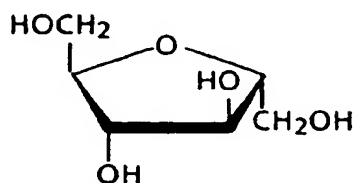
Also suitable are (IV) monosaccharides and oligosaccharides. For the purposes of the present invention, monosaccharides are defined as compounds having one five- or six-membered ring saccharide moiety, whereas oligosaccharides are defined as compounds having from two to about ten five- or six-membered ring saccharide moieties. Examples of suitable monosaccharides include (1) 1,4-anhydroerythritol (Aldrich 34,092-8), of the formula:



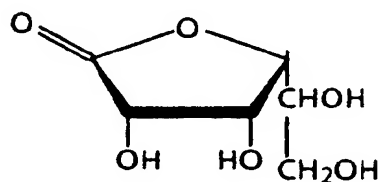
(2) 1,4-anhydro-L-threitol (Aldrich 34,093-6), of the formula:



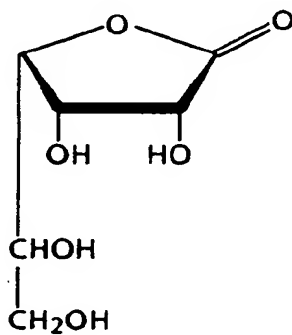
(3) 2,5-anhydro-D-mannitol (Aldrich 30,226-0), of the formula:



(4) L-gluconic  $\gamma$ -lactone (Aldrich 31,030-1), of the formula:



(5) D-gluconic  $\gamma$ -lactone (Aldrich 21,935-5), of the formula:

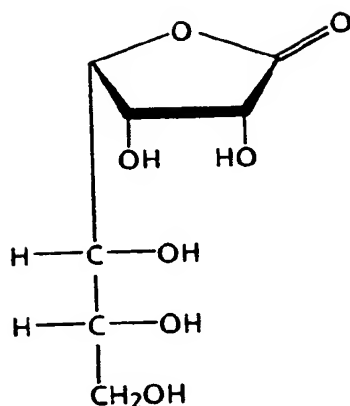


(6)  $\alpha$ -D-glucoheptonic  $\gamma$ -lactone (Aldrich 12,564-4), of the formula:

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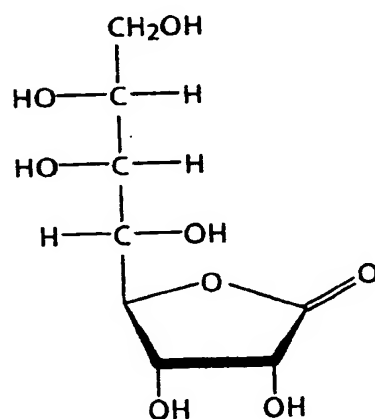


(7)  $\alpha,\beta$ -gluco octanoic- $\gamma$ -lactone (Aldrich 20,664-4), of the formula:

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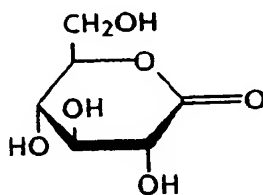
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35

(8)  $\delta$ -gluconolactone (Aldrich G200-1), of the formula:

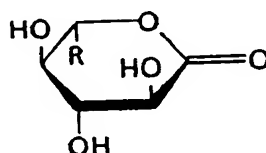
40



45

(9) L-glucono-1,5-lactone (Aldrich 33,232-10), of the formula:

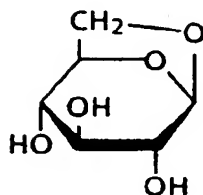
50



wherein R = CH<sub>2</sub>OH

55

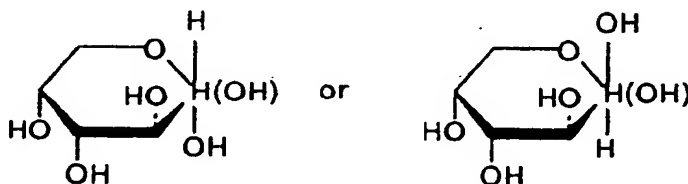
(10) 1,6-anhydro- $\beta$ -D-glucose (Aldrich 31,655-5), of the formula:



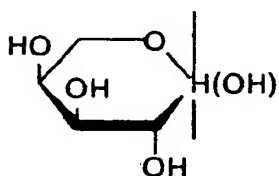
(11) D-arabinose (Aldrich 14,112-7), of the formula:



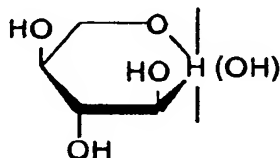
indicates that the substituents in the carbon atom are interchangeable, i.e., either



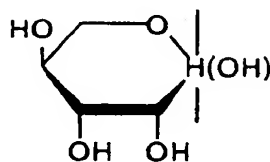
(12) L-arabinose (Aldrich A9,190-6), of the formula:



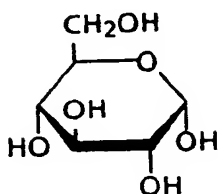
(13) L-xylose (Aldrich 85,159-0), of the formula:



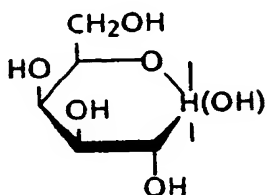
(14) D-xylose (Aldrich X107-5), of the formula:



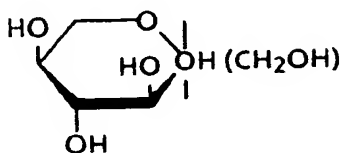
(15)  $\alpha$ -D-glucose (Aldrich 25,307-3), of the formula:



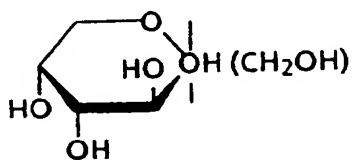
(16) D-galactose (Aldrich 11,259-3), of the formula:



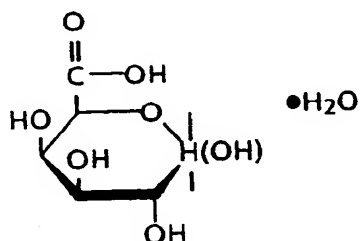
(17) L-sorbose (Aldrich 85,156-6), of the formula:



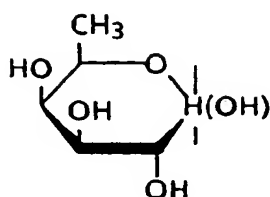
(18) D-fructose (Aldrich 14,092-9), of the formula:



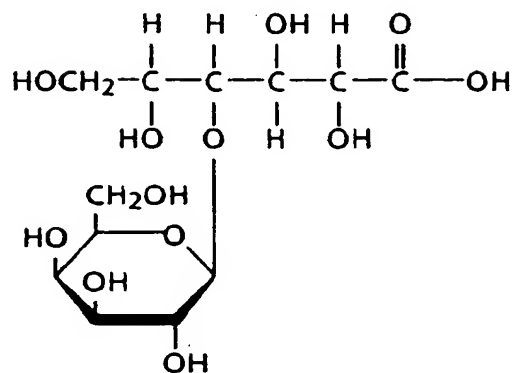
(19) D-galactouronic acid monohydrate (Aldrich 85,728-9), of the formula:



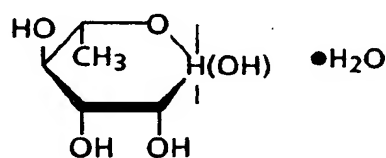
(20) D-fucose (rhodose) (Aldrich 85,028-4), of the formula:



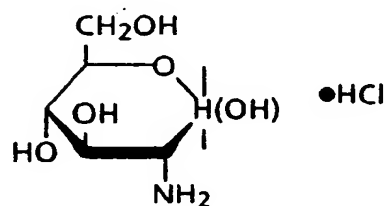
(21) lactobionic acid (Aldrich 15,351-6), of the formula:



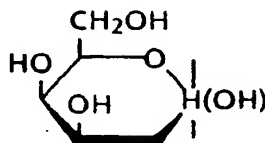
(22) L-rhamnose monohydrate (6-deoxy-L-mannose) (Aldrich 17,198-0), of the formula:



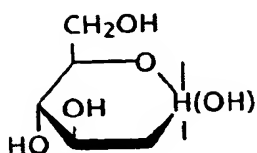
(23) D-glucosamine hydrochloride (Aldrich G220-6), of the formula:



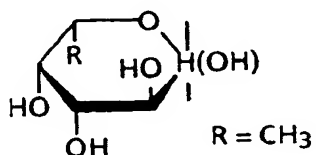
(24) 2-deoxy-D-galactose (Aldrich D440-7), of the formula:



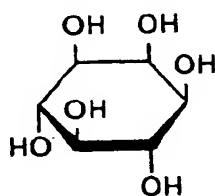
(25) 2-deoxy-D-glucose (Aldrich D460-1), of the formula:



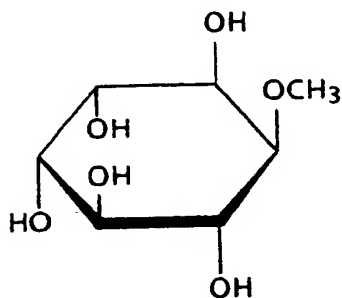
(26) L-fucose (6-deoxy-L-galactose) (Aldrich 85,138-8), of the formula:



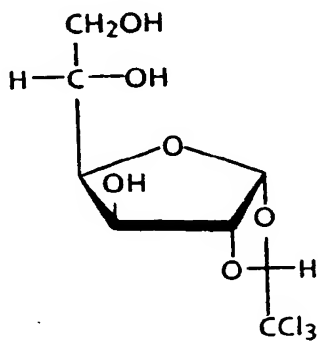
(27) inositol (Aldrich 1-665-2), of the formula:



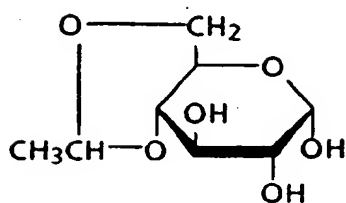
(28) (-)-quebrachitol (2-O-methyl-L-inositol) (Aldrich 36,060-0), of the formula:



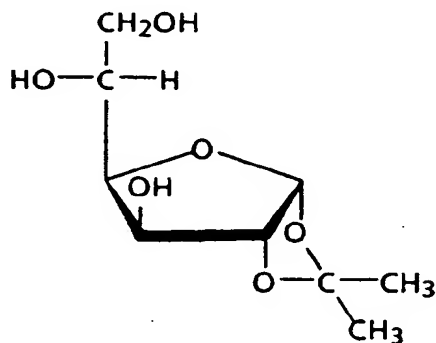
(29)  $\alpha$ -chloralose (Aldrich 10,620-8), of the formula:



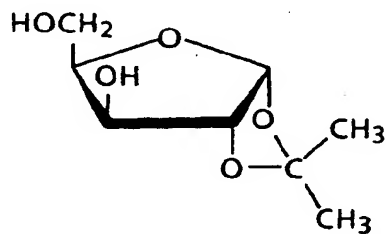
(30) 4,6-O-ethylidene- $\alpha$ -D-glucose (Aldrich E3,275-4), of the formula:



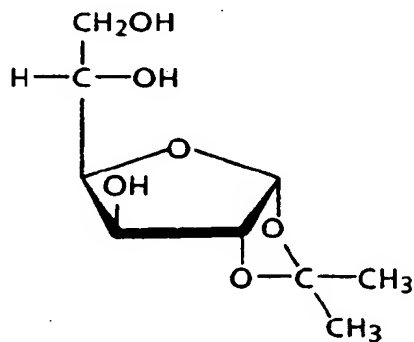
(31) 1,2-O-isopropylidene-D-glucofuranose (Aldrich I-2,290-0), of the formula:



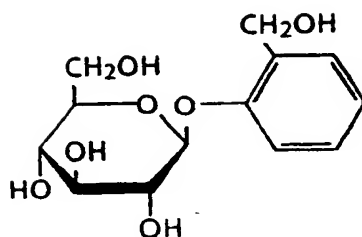
(32) 1,2-O-isopropylidene-D-xylofuranose (Aldrich 29,636-8), of the formula:



(33) 1,2-O-isopropylidene-β-L-idofuranose (Aldrich 30,225-2), of the formula:

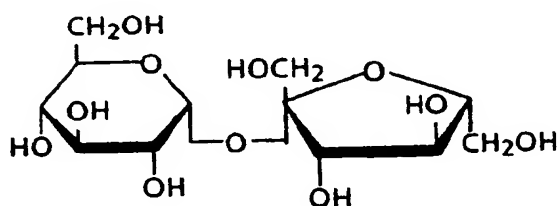


(34) salicin (Aldrich S30-5), of the formula:

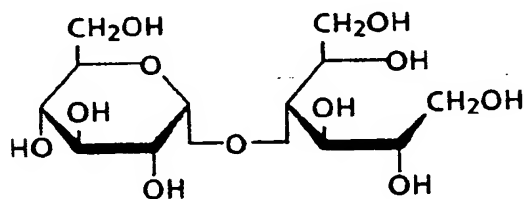


and the like.

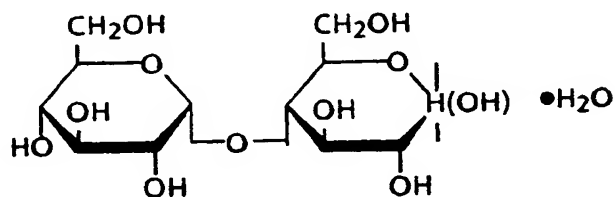
Examples of suitable oligosaccharides include (35) sucrose (Aldrich 24,761-8; 17,994-9), of the formula:



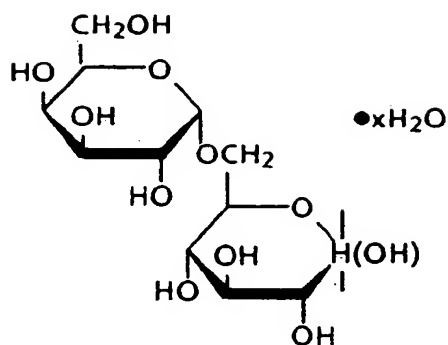
(36) maltitol (Aldrich 86,206-1), of the formula:



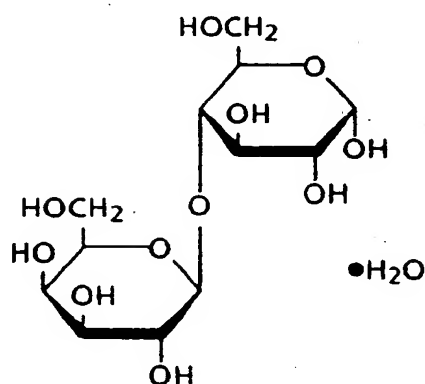
(37) D-maltose monohydrate (Aldrich 11,256-9), of the formula:



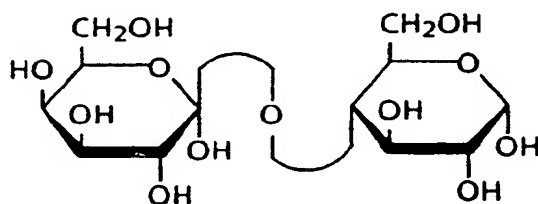
(38) α-D-melibiose hydrate (Aldrich M269-1), of the formula:



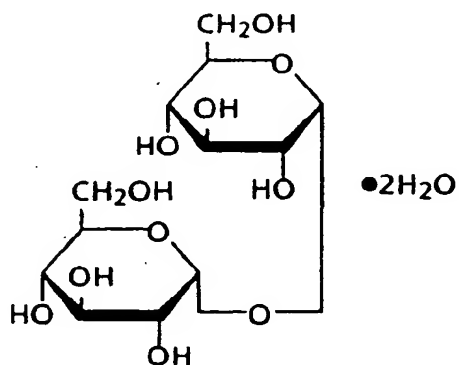
(39)  $\alpha$ -D-lactose monohydrate (Aldrich L25-4), of the formula:



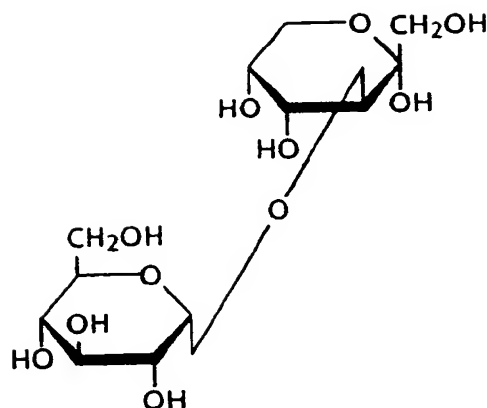
(40)  $\beta$ -D-Lactose (Aldrich 25,971-3), of the formula:



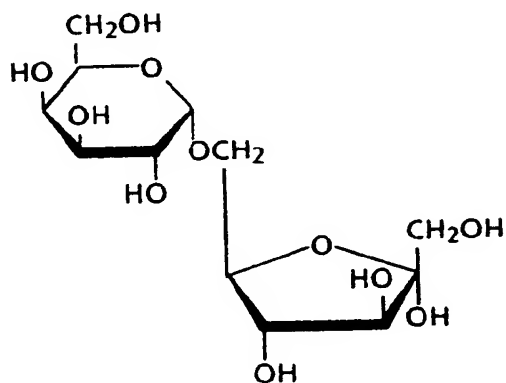
(41) D-trehalose dihydrate (Aldrich 18,835-2), of the formula:



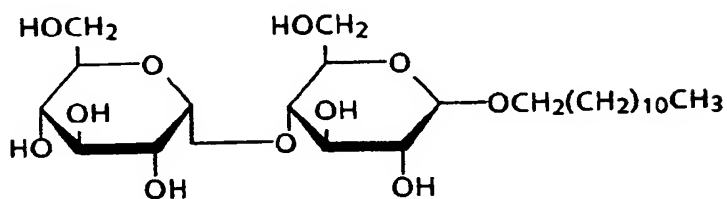
(42) D-turanose (3-O- $\alpha$ -D-glucopyranosyl-D-fructose) (Aldrich 28,737-7), of the formula:



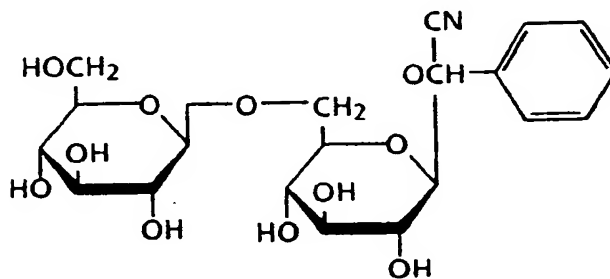
(43) palatinose (Aldrich 85,151-5), of the formula:



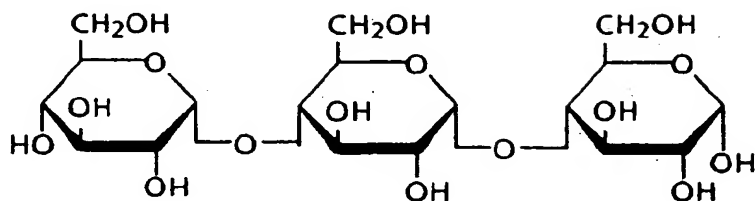
(44) dodecyl- $\beta$ -D-maltoside (Aldrich 86,231-2), of the formula:



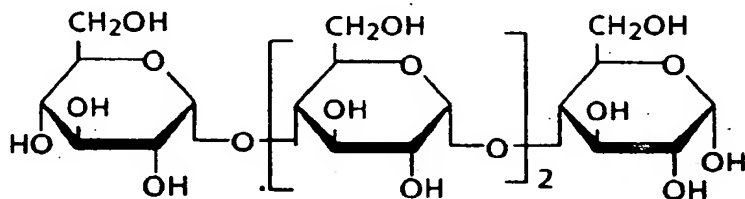
(45) D-amygdalin (Aldrich A8,320-2), of the formula:



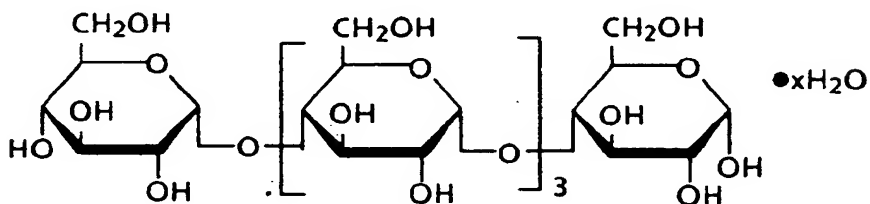
(46) maltotriose (Aldrich 85,149-3), of the formula:



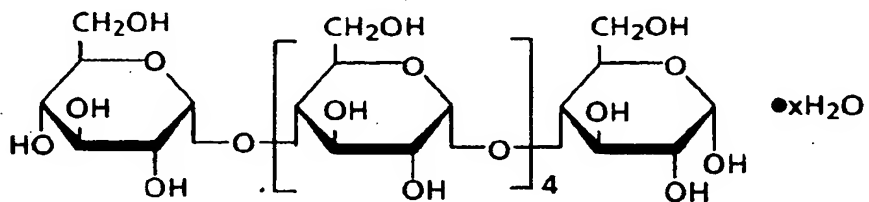
(47) maltotetrose (Aldrich 28,395-9), of the formula:



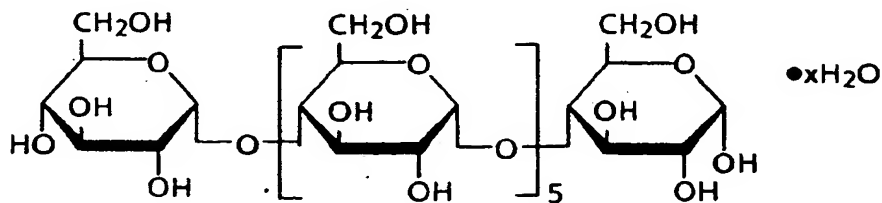
(48) maltopentaose hydrate (Aldrich 28403-3), of the formula:



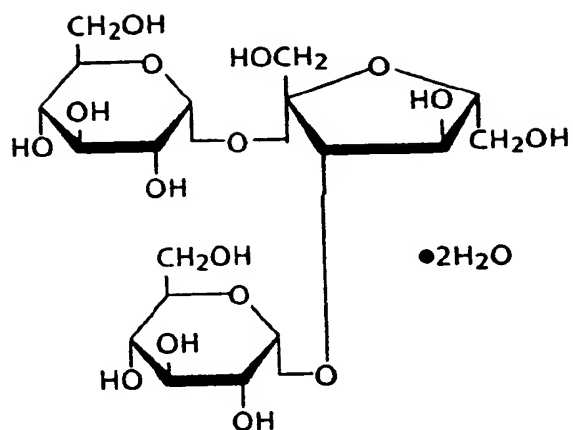
(49) maltohexaose hydrate (Aldrich 28,404-1), of the formula:



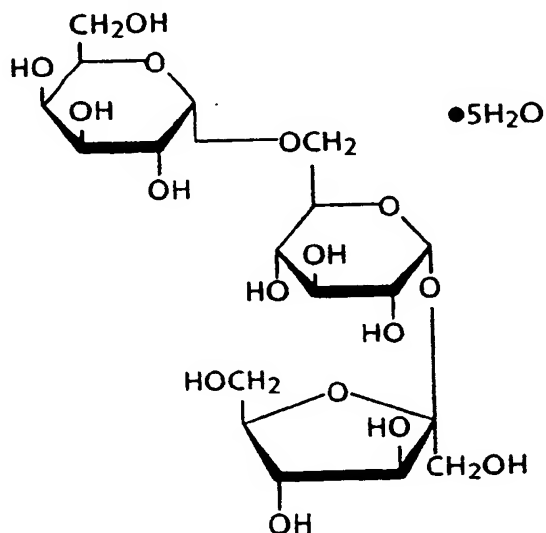
(50) maltoheptaose hydrate (Aldrich 28,401-7), of the formula:



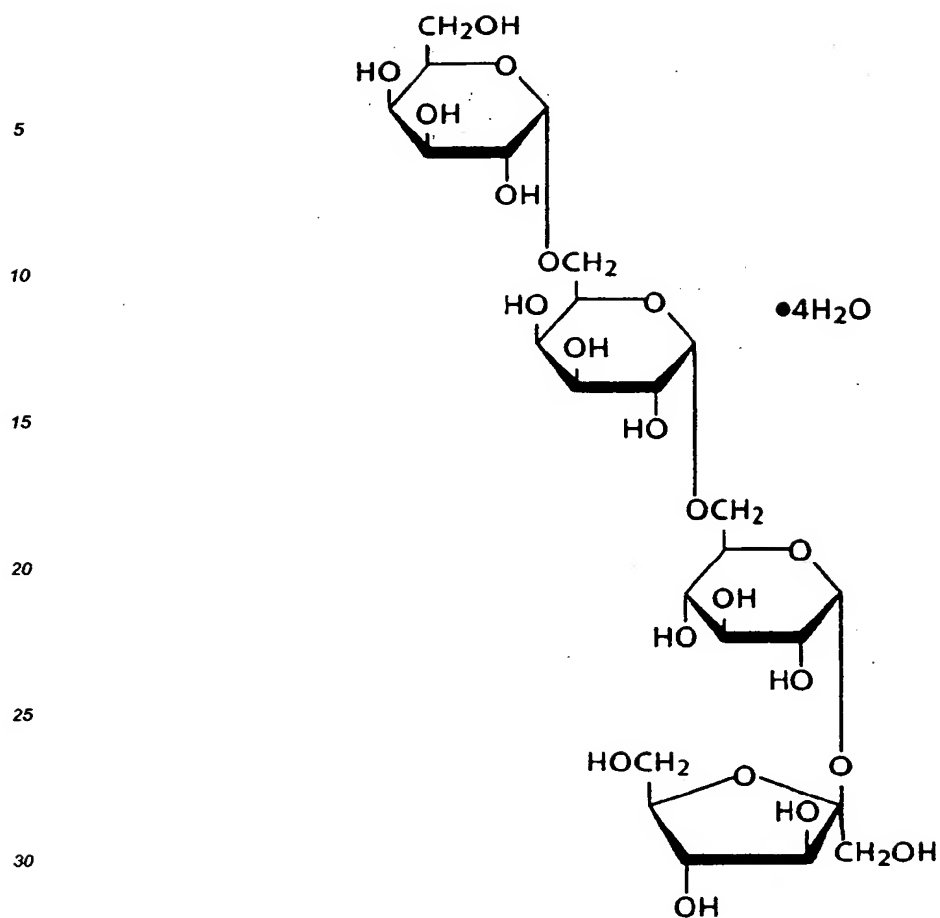
(51) melezitose dihydrate (Aldrich 85,037-3), of the formula:



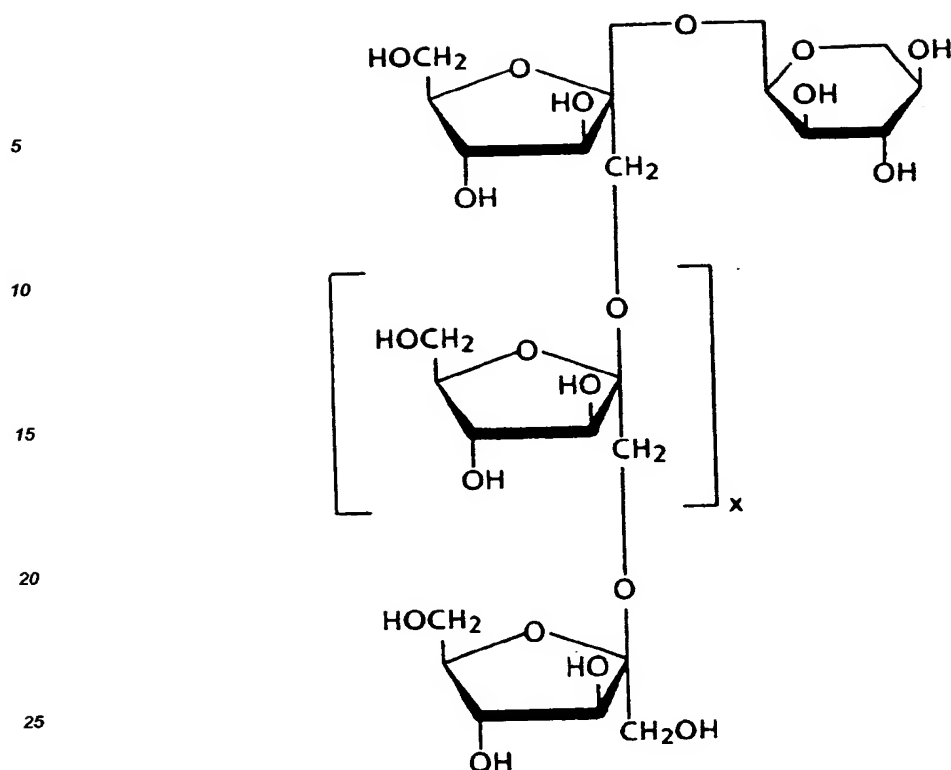
(52) D-raffinose pentahydrate (Aldrich 20,667-9), of the formula:



(53) stachyose tetrahydrate ( $\alpha$ -D-galactosyl- $\alpha$ -D-galactosyl- $\alpha$ -D-glucosyl- $\beta$ -D-fructose) (Aldrich 85,178-7), of the formula:



(54) inulin (Kodak 545, available from Eastman Kodak Co.), of the formula:



and the like.

Mixtures of any two or more of the above materials are also suitable.

The monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof is present in any effective amount relative to the substrate. Typically, the monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof is present in an amount of from about 1 to about 50 percent by weight of the substrate, preferably from about 5 to about 30 percent by weight of the substrate, although the amount can be outside this range. The amount can also be expressed in terms of the weight of monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof per unit area of substrate. Typically, the monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof is present in an amount of from about 0.8 to about 40 grams per square meter of the substrate surface to which it is applied, and preferably from about 4 to about 24 grams per square meter of the substrate surface to which it is applied, although the amount can be outside these ranges.

When the monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof is applied to the substrate as a coating, the coatings employed for the recording sheets of the present invention can include an optional binder in addition to the monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof. Examples of suitable binder polymers include (a) hydrophilic polysaccharides and their modifications, (b) vinyl polymers, (c) formaldehyde resins, (d) ionic polymers, (e) latex polymers, (f) maleic anhydride and maleic acid containing polymers, (g) acrylamide containing polymers, and (h) poly(alkylene imine) containing polymers, wherein alkylene has two (ethylene), three (propylene), or four (butylene) carbon atoms, and the like, as well as blends or mixtures of any of the above, with starches and latexes being particularly preferred because of their availability and applicability to paper. Specific examples of suitable binders are mentioned in U.S. application S.N. 08/196,922. Any mixtures of the above ingredients in any relative amounts can be employed.

If present, the binder can be present within the coating in any effective amount; typically the binder and the monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof are present in relative amounts of from about 10 percent by weight binder and about 90 percent by weight monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof to about 99 percent by weight binder and about 1 percent by weight monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof, although the relative amounts can be outside of this range.

In addition, the coating of the recording sheets of the present invention can contain optional antistatic agents. Any suitable or desired antistatic agent or agents can be employed, such as quaternary salts and other materials. The antistatic agent can be present in any effective amount; typically, the antistatic agent is present

in an amount of from about 1 to about 5 percent by weight of the coating, and preferably in an amount of from about 1 to about 2 percent by weight of the coating, although the amount can be outside these ranges.

Further, the coating of the recording sheets of the present invention can contain one or more optional biocides. Examples of suitable biocides include (A) non-ionic biocides, (B) anionic biocides, (C) cationic biocides; and the like, as well as mixtures thereof. Specific examples of suitable biocides are mentioned in U.S. application S.N. 08/196,922. The biocide can be present in any effective amount; typically, the biocide is present in an amount of from about 10 parts per million to about 3 percent by weight of the coating, although the amount can be outside this range.

Additionally, the coating of the recording sheets of the present invention can contain optional filler components. Fillers can be present in any effective amount, and if present, typically are present in amounts of from about 1 to about 60 percent by weight of the coating composition. Examples of filler components include colloidal silicas, such as Syloid 74, available from Grace Company (preferably present, in one embodiment, in an amount of about 20 weight percent). Other suitable fillers are mentioned in U.S. application S.N. 08/196,922.

The coating containing the monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof is present on the substrate of the recording sheet of the present invention in any effective thickness. Typically, the total thickness of the coating layer (on each surface of the substrate, when both sides are coated) is from about 1 to about 25 microns and preferably from about 5 to about 10 microns, although the thickness can be outside of these ranges.

The monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof or the mixture of monomeric alcohol, monosaccharide, oligosaccharide, or mixture thereof, optional binder, optional antistatic agent, optional biocide, and/or optional filler can be applied to the substrate by any suitable technique, such as size press treatment, dip coating, reverse roll coating, extrusion coating, or the like. For example, the coating can be applied with a KRK size press (Kumagai Riki Kogyo Co., Ltd., Nerima, Tokyo, Japan) by dip coating and can be applied by solvent extrusion on a Faustel Coater. The KRK size press is a lab size press that simulates a commercial size press. This size press is normally sheet fed, whereas a commercial size press typically employs a continuous web. On the KRK size press, the substrate sheet is taped by one end to the carrier mechanism plate. The speed of the test and the roll pressures are set, and the coating solution is poured into the solution tank. A 4 liter stainless steel beaker is situated underneath for retaining the solution overflow. The coating solution is cycled once through the system (without moving the substrate sheet) to wet the surface of the rolls and then returned to the feed tank, where it is cycled a second time. While the rolls are being "wetted", the sheet is fed through the sizing rolls by pressing the carrier mechanism start button. The coated sheet is then removed from the carrier mechanism plate and is placed on a 12 inch by 40 inch (30x100cm) sheet of 750  $\mu$ m thick Teflon for support and is dried on the Dynamic Former drying drum and held under restraint to prevent shrinkage. The drying temperature is approximately 105°C. This method of coating treats both sides of the substrate simultaneously.

In dip coating, a web of the material to be coated is transported below the surface of the liquid coating composition by a single roll in such a manner that the exposed site is saturated, followed by removal of any excess coating by the squeeze rolls and drying at 100°C in an air dryer. The liquid coating composition generally comprises the desired coating composition dissolved in a solvent such as water, methanol, or the like. The method of surface treating the substrate using a coater results in a continuous sheet of substrate with the coating material applied first to one side and then to the second side of this substrate. The substrate can also be coated by a slot extrusion process, wherein a flat die is situated with the die lips in close proximity to the web of substrate to be coated, resulting in a continuous film of the coating solution evenly distributed across one surface of the sheet, followed by drying in an air dryer at 100°C.

Recording sheets of the present invention can be employed in ink jet printing processes. One embodiment of the present invention is directed to a process which comprises applying an aqueous recording liquid to a recording sheet of the present invention in an imagewise pattern. Another embodiment of the present invention is directed to a printing process which comprises (1) incorporating into an ink jet printing apparatus containing an aqueous ink a recording sheet of the present invention, and (2) causing droplets of the ink to be ejected in an imagewise pattern onto the recording sheet, thereby generating images on the recording sheet. Ink jet printing processes are well known, and are described in, for example, US-A-4,601,777, US-A-4,251,824, US-A-4,410,899, US-A-4,412,224, and US-A-4,532,530. In a particularly preferred embodiment, the printing apparatus employs a thermal ink jet process wherein the ink in the nozzles is selectively heated in an imagewise pattern, thereby causing droplets of the ink to be ejected in imagewise pattern. In another preferred embodiment, the substrate is printed with an aqueous ink and thereafter the printed substrate is exposed to microwave radiation, thereby drying the ink on the sheet. Printing processes of this nature are disclosed in, for example, US-A-5,220,346.

Recording sheets of the present invention exhibit reduced curl upon being printed with aqueous inks, particularly in situations wherein the ink image is dried by exposure to microwave radiation. Generally, the term "curl" refers to the distance between the base line of the arc formed by recording sheet when viewed in cross-section across its width (or shorter dimension - for example, 8.5 inches (21.6cm) in an 8.5 x 11 inch (21.6x27.9cm) sheet, as opposed to length, or longer dimension - for example, 11 inches (27.9cm) in an 8.5 x 11 inch (21.6x27.9cm) sheet) and the midpoint of the arc. To measure curl, a sheet can be held with the thumb and forefinger in the middle of one of the long edges of the sheet (for example, in the middle of one of the 11 inch (21.6cm) edges in an 8.5 x 11 inch (21.6x27.9cm) sheet) and the arc formed by the sheet can be matched against a pre-drawn standard template curve.

The recording sheets of the present invention can also be used in any other printing or imaging process, such as printing with pen plotters, handwriting with ink pens, offset printing processes, or the like, provided that the ink employed to form the image is compatible with the ink receiving layer of the recording sheet.

Specific embodiments of the invention will now be described in detail. These examples are intended to be illustrative, and the invention is not limited to the materials, conditions, or process parameters set forth in these embodiments. All parts and percentages are by weight unless otherwise indicated.

The optical density measurements recited herein were obtained on a Pacific Spectrograph Color System. The system consists of two major components, an optical sensor and a data terminal. The optical sensor employs a 6 inch (15cm) integrating sphere to provide diffuse illumination and 8 degrees viewing. This sensor can be used to measure both transmission and reflectance samples. When reflectance samples are measured, a specular component may be included. A high resolution, full dispersion, grating monochromator was used to scan the spectrum from 380 to 720 nanometers. The data terminal features a 12 inch (30cm) CRT display, numerical keyboard for selection of operating parameters and the entry of tristimulus values, and an alphanumeric keyboard for entry of product standard information.

## EXAMPLE I

Transparency sheets were prepared as follows. Blends of 70 percent by weight hydroxypropyl methyl cellulose (K35LV, obtained from Dow Chemical Co.) and 30 percent by weight of various additive compositions, each obtained from Aldrich Chemical Co., were prepared by mixing 56 grams of hydroxypropyl methyl cellulose and 24 grams of the additive composition in 1,000 milliliters of water in a 2 Liter jar and stirring the contents in an Omni homogenizer for 2 hours. Subsequently, the solution was left overnight for removal of air bubbles. The blends thus prepared were then coated by a dip coating process (both sides coated in one operation) by providing Mylar® base sheets in cut sheet form (8.5 x 11 inches; 21.6x27.9cm) in a thickness of 100 µm. Subsequent to air drying at 25°C for 3 hours followed by oven drying at 100°C for 10 minutes and monitoring the difference in weight prior to and subsequent to coating, the dried coated sheets were each coated with 1 gram, 10 µm in thickness, on each surface (2 grams total coating weight for 2-sided transparency) of the substrate. For comparison purposes, a transparency sheet was also prepared in which the coating consisted of 100 percent by weight hydroxypropyl methyl cellulose and contained no additive composition.

The transparency sheets thus prepared were incorporated into a Hewlett-Packard 500-C color ink jet printer containing inks of the following compositions:

- Cyan: 20 percent by weight ethylene glycol, 2.5 percent by weight benzyl alcohol, 1.9 percent by weight ammonium chloride, 0.1 percent by weight Dowicil 150 biocide, obtained from Dow Chemical Co., Midland, MI, 0.05 percent by weight polyethylene oxide (molecular weight 18,500), obtained from Union Carbide Co.), 30 percent by weight Projekt Cyan 1 dye, obtained from ICI, 45.45 percent by weight water.
- Magenta: 20 percent by weight ethylene glycol, 2.5 percent by weight benzyl alcohol, 1.9 percent by weight ammonium chloride, 0.1 percent by weight Dowicil 150 biocide, obtained from Dow Chemical Co., Midland, MI, 0.05 percent by weight polyethylene oxide (molecular weight 18,500), obtained from Union Carbide Co.), 2.5 percent by weight Triton Direct Red 227, obtained from Tricon, 72.95 percent by weight water.
- Yellow: 20 percent by weight ethylene glycol, 2.5 percent by weight benzyl alcohol, 1.9 percent by weight ammonium chloride, 0.1 percent by weight Dowicil 150 biocide, obtained from Dow Chemical Co., Midland, MI, 0.05 percent by weight polyethylene oxide (molecular weight 18,500), obtained from Union Carbide Co.), 3 percent by weight Hoechst Duasyn Brilliant Yellow SF-GL VP220, obtained from Hoechst, 72.45 percent by weight water.

Images were generated by printing block patterns for magenta, cyan, yellow, and black. The images thus formed were dried by exposure to microwave radiation with a Citizen Model No. JM55581, obtained from Consumers, Mississauga, Ontario, Canada, set at 700 Watts output power at 2450 MHz frequency. The black im-

ages were "process black" (i.e., formed by superimposition of cyan, magenta, and yellow images). The drying times and optical densities for the resulting images were as follows:

Additive	Drying Time (seconds)				Optical Density			
	black	cyan	magenta	yellow	black	cyan	magenta	yellow
none	30	20	30	20	2.50	2.07	1.45	0.99
pentaerythritol	25	10	5	15	1.80	1.50	1.42	0.94
xylitol	30	20	30	20	2.00	2.00	1.50	0.90
(±)-pantothenol	10	10	10	10	1.90	2.10	1.40	1.00
1,1,1-tris (hydroxy methyl) ethane	40	10	10	10	1.95	1.94	1.45	0.97
D-sorbitol	20	30	30	20	1.60	1.90	1.70	1.00

As the results indicate, the drying times of all colors were equivalent or faster in the presence of the additives than in their absence. In addition, the optical densities of the images were also acceptable and in some instances were improved.

#### EXAMPLE II

Transparency sheets were prepared as follows. Blends of 90 percent by weight hydroxypropyl methyl cellulose (K35LV, obtained from Dow Chemical Co.) and 10 percent by weight of various additive compositions, each obtained from Aldrich Chemical Co., were prepared by mixing 72 grams of hydroxypropyl methyl cellulose and 8 grams of the additive composition in 1,000 milliliters of water in a 2 Liter jar and stirring the contents in an Omni homogenizer for 2 hours. Subsequently, the solution was left overnight for removal of air bubbles. The blends thus prepared were then coated by a dip coating process (both sides coated in one operation) by providing Mylar® base sheets in cut sheet form (8.5 × 11 inches; 21.6x27.9cm) in a thickness of 100 μm. Subsequent to air drying at 25°C for 3 hours followed by oven drying at 100°C for 10 minutes and monitoring the difference in weight prior to and subsequent to coating, the dried coated sheets were each coated with 1 gram, 10 μm in thickness, on each surface (2 grams total coating weight for 2-sided transparency) of the substrate. For comparison purposes, a transparency sheet was also prepared in which the coating consisted of 100 percent by weight hydroxypropyl methyl cellulose and contained no additive composition.

The transparency sheets thus prepared were incorporated into a Hewlett-Packard 500-C color ink jet printer containing inks of the following compositions:

Cyan: Same as Example I.

Magenta: Same as Example I.

Yellow: Same as Example I.

Images were generated by printing block patterns for magenta, cyan, yellow, and black. The images thus formed were allowed to dry at 25°C. The black images were "process black" (i.e., formed by superimposition of cyan, magenta, and yellow images). The drying times and optical densities for the resulting images were as follows:

Additive	Drying Time (minutes)				Optical Density			
	black	cyan	magenta	yellow	black	cyan	magenta	yellow
none	10	5	5	2	2.95	2.10	1.37	0.99
pentaerythritol	6	2	3	1	2.70	1.67	1.25	1.03
xylitol	8	2.5	5	1	2.60	1.86	1.58	0.98
(±)-pantothenol	6	2.5	2.5	1	2.70	1.80	1.45	1.03
1,1,1-tris (hydroxy methyl) ethane	8	2	4.5	1	2.60	1.71	1.30	1.02
α-d-glucose	7	2	2	2	2.96	2.80	1.40	0.69
D-sorbitol	7	2	2	2	2.90	2.70	1.27	0.70

As the results indicate, the drying times of the transparencies containing the additives were generally faster than the drying times of the transparency containing no additives. In addition, the optical densities of the images on the transparencies containing the additives were acceptable and in some instances improved compared to those on the transparencies containing no additives.

### EXAMPLE III

Transparency sheets were prepared as follows. Blends of 90 percent by weight hydroxypropyl methyl cellulose (K35LV, obtained from Dow Chemical Co.) and 10 percent by weight of various additive compositions, each obtained from Aldrich Chemical Co., were prepared by mixing 72 grams of hydroxypropyl methyl cellulose and 8 grams of the additive composition in 1,000 milliliters of water in a 2 Liter jar and stirring the contents in an Omni homogenizer for 2 hours. Subsequently, the solution was left overnight for removal of air bubbles. The blends thus prepared were then coated by a dip coating process (both sides coated in one operation) by providing Mylar® base sheets in cut sheet form (8.5 × 11 inches; 21.6x27.gcm) in a thickness of 100 μm. Subsequent to air drying at 25°C for 3 hours followed by oven drying at 100°C for 10 minutes and monitoring the difference in weight prior to and subsequent to coating, the dried coated sheets were each coated with 1 gram, 10 μm in thickness, on each surface (2 grams total coating weight for 2-sided transparency) of the substrate. For comparison purposes, a transparency sheet was also prepared in which the coating consisted of 100 percent by weight hydroxypropyl methyl cellulose and contained no additive composition. The transparency sheets thus prepared were incorporated into a Hewlett-Packard 500-C color ink jet printer containing inks of the following compositions:

Cyan: Same as Example I.

Magenta: Same as Example I.

Yellow: Same as Example I.

Images were generated by printing block patterns for magenta, cyan, yellow, and black. The images thus formed were allowed to dry at 25°C. The black images were "process black" (i.e., formed by superimposition of cyan, magenta, and yellow images). The drying times and optical densities for the resulting images were as follows:

Additive	Optical Density			
	black	cyan	magenta	yellow
none	2.95	2.10	1.37	0.99
L-ascorbic acid	2.80	2.05	1.40	0.68
D-gluconic acid	2.97	2.83	1.40	0.70
lactobionic acid	2.91	2.80	1.40	0.69
$\alpha$ -D-lactose monohydrate	2.96	2.85	1.39	0.67
$\beta$ -D-lactose	2.95	2.80	1.40	0.70
D-maltose monohydrate	2.95	2.90	1.40	0.75
N-methyl-D-glucamine	2.60	2.54	1.36	0.69
dulcitol	2.80	2.72	1.40	0.68
inositol	2.70	2.90	1.40	0.75
D-raffinose pentahydrate	2.90	2.78	1.30	0.63

As the results indicate, in the presence of the additive, the optical density of the cyan images was enhanced, particularly in cases such as wherein the transparency contained inositol, D-gluconic acid, lactobionic acid,  $\beta$ -D-lactose, and D-maltose monohydrate.

#### EXAMPLE IV

Transparency sheets were prepared as follows. Blends of 54 percent by weight hydroxypropyl methyl cellulose (K35LV, obtained from Dow Chemical Co.), 36 percent by weight poly(ethylene oxide) (POLY OX WSRN-3000, obtained from Union Carbide Corp.), and 10 percent by weight of various additive compositions, each obtained from Aldrich Chemical Co., were prepared by mixing 43.2 grams of hydroxypropyl methyl cellulose, 28.8 grams of poly(ethylene oxide), and 8 grams of the additive composition in 1,000 milliliters of water in a 2 Liter jar and stirring the contents in an Omni homogenizer for 2 hours. Subsequently, the solution was left overnight for removal of air bubbles. The blends thus prepared were then coated by a dip coating process (both sides coated in one operation) by providing Mylar® base sheets in cut sheet form (8.5 × 11 inches; 21.6x27.9cm) in a thickness of 100  $\mu$ m. Subsequent to air drying at 25°C for 3 hours followed by oven drying at 100°C for 10 minutes and monitoring the difference in weight prior to and subsequent to coating, the dried coated sheets were each coated with 1 gram, 10  $\mu$ m in thickness, on each surface (2 grams total coating weight for 2-sided transparency) of the substrate. For comparison purposes, a transparency sheet was also prepared in which the coating consisted of 60 percent by weight hydroxypropyl methyl cellulose and 40 percent by weight poly(ethylene oxide) and contained no additive composition.

The transparency sheets thus prepared were incorporated into a Hewlett-Packard 500-C color ink jet printer containing inks of the following compositions:

Cyan: Same as Example I.

Magenta: Same as Example I.

Yellow: Same as Example I.

Images were generated by printing block patterns for magenta, cyan, yellow, and black. The images thus formed were allowed to dry at 25°C. The black images were "process black" (i.e., formed by superimposition of cyan, magenta, and yellow images). The drying times and optical densities for the resulting images were as follows:

Additive	Drying Time (minutes)				Optical Density			
	black	cyan	magenta	yellow	black	cyan	magenta	yellow
none	15	10	10	10	1.40	1.46	1.34	1.02
pentaerythritol	6	3	3	2	1.45	1.40	1.30	0.95
1,1,1-tris (hydroxy methyl) ethane	6	3	3	3	1.44	1.42	1.26	0.86
1,1,1-tris (hydroxy methyl) amino methane	7	4	3	3	1.47	1.46	1.32	0.96
(±)-pantothenol	8	4	4	3	1.42	1.37	1.23	0.90
D,L-threitol	8	4	4	3	1.45	1.44	1.27	0.95
xylitol	8	4	4	3	1.44	1.39	1.20	0.94

As the results indicate, the drying times of the transparencies containing the additives were generally faster than the drying times of the transparency containing no additives. In addition, the optical densities of the images on the transparencies containing the additives were acceptable and in some instances improved compared to those on the transparencies containing no additives.

#### EXAMPLE V

Paper recording sheets were prepared as follows. Coating compositions containing various additive compositions, each obtained from Aldrich Chemical Co., were prepared by dissolving 50 grams of the additive in 500 milliliters of water in a beaker and stirring for 1 hour at 25°C. The additive solutions thus prepared were then coated onto paper by a dip coating process (both sides coated in one operation) by providing paper base sheets in cut sheet form (8.5 × 11 inches; 21.6x27.9cm) in a thickness of 100 μm. Subsequent to air drying at 100°C for 10 minutes and monitoring the difference in weight prior to and subsequent to coating, the sheets were each coated on each side with 500 milligrams, in a thickness of 5 μm (total coating weight 1 gram for two-sided sheets), of the additive composition. For comparison purposes, an uncoated paper sheet treated with a composition containing only water by the same procedure was also imaged.

The paper sheets thus prepared were incorporated into a Hewlett-Packard 500-C color ink jet printer containing inks of the following composition:

Cyan: Same as Example I.

Magenta: Same as Example I.

Yellow: Same as Example I.

Images were generated with 100 percent ink coverage. After the image was printed, the paper sheets were each weighed precisely in a precision balance at time zero and periodically after that. The difference in weight was recorded as a function of time, 100 minutes being considered as the maximum time required for most of the volatile ink components to evaporate. (Volatiles were considered to be ink components such as water and glycols that can evaporate, as compared to components such as dyes, salts, and/or other non-volatile components. Knowing the weight of ink deposited at time zero, the amount of volatiles in the image can be calculated.) After 1000 minutes, the curl values of the paper were measured and are listed in the Table below. The black images were "process black" (i.e., formed by superimposition of cyan, magenta, and yellow images).

Additive	Percent weight-loss of volatiles at various times (minutes)						1,000 minutes	
	5	10	15	30	60	120	wt. loss %	curl in mm
none	32	43	45	48	50	53	65	125
pentaerythritol	34	47	54	63	70	74	100	0
(±)-pantothenol	24	43	49	55	58	63	89	10
xylitol	38	52	59	63	66	71	100	0
1,1,1-tris (hydroxy methyl) ethane	41	60	64	66	68	71	100	0
1,3,5-tris (hydroxy ethyl)-cyanouric acid	43	55	58	62	65	68	86	15
inositol	36	54	59	63	64	73	100	0
D-raffinose pentahydrate	27	40	46	51	52	57	80	20
lactobionic acid	41	54	57	62	66	70	100	0
α-D-glucose	37	44	54	64	65	68	91	10
β-D-lactose monohydrate	40	52	56	59	61	65	74	25
D-mannitol	38	53	57	61	64	65	71	30
S-sorbitol	13	23	33	56	76	84	95	5

As the results indicate, the papers coated with the additives exhibited higher weight loss of volatiles at time 1,000 minutes compared to the paper which had been treated with water alone. In addition, the papers coated with the additives exhibited lower curl values compared to the curl value for the paper treated with water alone.

#### EXAMPLE VI

Paper recording sheets were prepared as follows. Coating compositions containing various additive compositions, each obtained from Aldrich Chemical Co., were prepared by dissolving 50 grams of the additive in 500 milliliters of water in a beaker and stirring for 1 hour at 25°C. The additive solutions thus prepared were then coated onto paper by a dip coating process (both sides coated in one operation) by providing paper base sheets in cut sheet form (8.5 × 11 inches; 21.6 × 27.9 cm) in a thickness of 100 μm. Subsequent to air drying at 100°C for 10 minutes and monitoring the difference in weight prior to and subsequent to coating, the sheets were each coated on each side with 500 milligrams, in a thickness of 5 μm (total coating weight 1 gram for two-sided sheets), of the additive composition. For comparison purposes, an uncoated paper sheet treated with a composition containing only water by the same procedure was also imaged.

The paper sheets thus prepared were incorporated into a Hewlett-Packard 500-C color ink jet printer containing inks of the following composition:

Cyan: Same as Example I.  
Magenta: Same as Example I.  
Yellow: Same as Example I.

The black images were "process black" (i.e., formed by superimposition of cyan, magenta, and yellow images). The optical densities for the resulting images were as follows:

Additive	Optical Density			
	black	cyan	magenta	yellow
none	1.08	1.18	1.03	0.80
pentaerythritol	1.30	1.29	1.17	0.91
(±)-pantothenol	1.20	1.24	1.06	0.77
xylitol	1.26	1.29	1.12	0.79
1,1,1-tris (hydroxy methyl) ethane	1.20	1.27	1.09	0.82
1,3,5-tris (hydroxy ethyl) cyanouric acid	1.18	1.25	1.10	0.80
inositol	1.17	1.27	1.11	0.79
D-raffinose pentahydrate	1.16	1.26	1.08	0.78
lactobionic acid	1.07	1.10	0.98	0.73
α-D-glucose	1.36	1.35	1.17	0.94
β-D-lactose monohydrate	1.24	1.32	1.15	0.84
D-mannitol	1.15	1.28	1.08	0.82
D-sorbitol	1.38	1.17	1.17	0.89

As the results indicate, the papers coated with the additive compositions exhibited acceptable optical densities for all colors.

### Claims

1. A recording sheet which comprises a substrate, for example paper or a transparent polymeric material, and an additive material selected from the group consisting of monosaccharides, oligosaccharides, and mixtures thereof.
2. A recording sheet according to claim 1 wherein the additive material is present on the substrate in an amount of (1) from about 1 to about 50 percent by weight of the substrate, or (2) from about 0.8 to about 40 grams per square meter of the substrate.
3. A recording sheet according to claim 1 or 2, further including a binder, wherein the binder comprises (1) a polysaccharide, or (2) a quaternary acrylic copolymer latex.
4. A recording sheet according to claim 3 wherein a binder and the additive material (1) are present in relative amounts of from about 10 percent by weight binder and about 90 percent by weight additive material to about 99 percent by weight binder and about 1 percent by weight additive material, and/or (2) are coated onto the substrate in a thickness of from about 1 to about 25 μm.
5. A recording sheet according to any of claims 1 to 4, wherein the additive is (A) a monomeric alcohol, (B) a monosaccharide, (C) an oligosaccharide, or (D) an aliphatic alcohol.
6. A recording sheet according to any of claims 1 to 4, wherein the additive is (A) selected from the group consisting of (1) pentaerythritol; (2) dipentaerythritol; (3) tripentaerythritol; (4) 1,2,7,8-octane tetrol; (5) erythrose; (6) threitol; (7) meso-erythritol; (8) xylitol; (9) trishydroxymethyl ethane; (10) choline hydroxide; (11) tris (hydroxymethyl) amino methane; (12) tris (hydroxymethyl) nitro methane; (13) 2-ethyl-2-(hydroxymethyl)-1,3-propane diol; (14) pantothenol; (15) 1-[N,N-bis (2-hydroxyethyl) amino]-2-propanol; (16) N,N,N',N'-tetrakis (2-hydroxypropyl) ethylene diamine; (17) N,N,N',N"-pentakis (2-hydroxypropyl) diethylene triamine; (18) erythrulose hydrate; (19) xylulose; (20) arabitol; (21) adonitol; (22) iditol; (23) dulcitol; (24) n-methyl D-glucamine; (25) gluconic acid; (26) sorbitol; (27) mannitol; (28) 2,5-O-methylene-

mannitol; (29) 3,4-O-isopropylidene-mannitol; (30) 1,2,5,6-di-O-isopropylidene-mannitol; (31) glycerogulo-heptose; (32) glycerogulo-heptonic acid, sodium dihydrate; and mixtures thereof, (B) an aromatic alcohol, or (C) selected from the group consisting of (1) pyrogallol; (2) phloroglucinol dihydrate; (3) 1,1,1-trihydroxyphenyl ethane; (4) 2',3',4',-trihydroxyacetophenone; (5) 2',4',6',-trihydroxyacetophenone monohydrate; (6) 2,3,4-trihydroxybenzaldehyde; (7) 2,4,6-trihydroxybenzaldehyde hydrate; (8) 3,4,5-trihydroxybenzaldehyde monohydrate; (9) 2,3,4-trihydroxy benzoic acid; (10) 2,4,6-trihydroxy benzoic acid monohydrate; (11) 1,3,5 cyclohexane triol dihydrate; (12) 1,3,4,5-tetrahydroxy cyclohexane carboxylic acid; (13) 2,2',4,4'-tetrahydroxybenzophenone; (14) tetrahydroxy-1,4-benzoquinone hydrate; (15) purpurogallin; (16) glyoxal-trimeric dihydrate; (17) quinalizarin; (18) emodin; (19) hydrindantin dihydrate; (20) ellagic acid dihydrate; (21) quercetin dihydrate (3,3',4',5,7-pentahydroxy flavone dihydrate; (22) morinhydrate (2',3,4,5,7-pentahydroxy flavone hydrate; (23) myricetin; (24) lacmoid; (25) laudanoline hydrobromide trihydrate; (26) tetrahydropapaveroline hydrobromide; (27) esculin monohydrate; (28) hesperidin; (29) hesperidin methyl chalcone; (30) rutin trihydrate; (31) 3',5,7-trihydroxy-4'-methoxyflavone-7 rutinoside; (32) naringin hydrate; (33) tetracycline hydrochloride; (34) chlorotetracycline hydrochloride; and mixtures thereof.

7. A recording sheet according to any of claims 1 to 4, wherein the additive is (A) a heterocyclic alcohol, (B) selected from the group consisting of (1) ascorbic acid; (2) isoascorbic acid; (3) 5,6-isopropylidene-L-ascorbic acid; (4) shikimic acid; (5) cyanuric acid; (6) 1,3,5-tris (2-hydroxyethyl) cyanuric acid; and mixtures thereof, or (C) a monosaccharide.
8. A recording sheet according to any of claims 1 to 4, wherein the additive is (A) selected from the group consisting of (1) 1,4-anhydroerythritol; (2) 1,4-anhydro-threitol; (3) 2,5-anhydro-mannitol; (4) gluconic  $\gamma$ -lactone; (5)  $\alpha$ -glucoheptonic  $\gamma$ -lactone; (6)  $\alpha,\beta$ -gluco octanoic- $\gamma$ -lactone; (7)  $\delta$ -gluconolactone; (8) glucono-1,5-lactone; (9) 1,6-anhydro- $\beta$ -glucose; (10) arabinose; (11) xylose; (12)  $\alpha$ -glucose; (13) galactose; (14) sorbose; (15) fructose; (16) galactouronic acid monohydrate; (17) fucose; (18) lactobionic acid; (19) rhamnose monohydrate; (20) glucosamine hydrochloride; (21) 2-deoxy-galactose; (22) 2-deoxy-glucose; (23) inositol; (24) quebrachitol; (25)  $\alpha$ -chloralose; (26) 4,6-O-ethylidene- $\alpha$ -glucose; (27) 1,2-O-isopropylidene-glucofuranose; (28) 1,2-O-isopropylidene-xylofuranose; (29) 1,2-O-isopropylidene- $\beta$ -idofuranose; (30) salicin; and mixtures thereof, (B) an oligosaccharide, or (C) selected from the group consisting of (1) sucrose; (2) maltitol; (3) maltose monohydrate; (4)  $\alpha$ -melibiose hydrate; (5)  $\alpha$ -lactose monohydrate; (6)  $\beta$ -lactose; (7) trehalose dihydrate; (8) turanose; (9) palatinose; (10) dodecyl- $\beta$ -maltoside; (11) amygdalin; (12) maltotriose; (13) maltotetraose; (14) maltopentaose hydrate; (15) maltohexaose hydrate; (16) maltoheptaose hydrate; (17) melezitose dihydrate; (18) raffinose pentahydrate; (19) stachyose tetrahydrate; (20) inulin; and mixtures thereof.
9. A process which comprises applying an aqueous recording liquid in an imagewise pattern to a recording sheet according to any of the preceding claims, the process preferably comprising (1) incorporating the recording sheet into an ink jet printing apparatus containing an aqueous ink, and (2) causing droplets of the ink to be ejected in an imagewise pattern onto the recording sheet, thereby generating images on the recording sheet.
10. A process according to claim 9, wherein the recording sheet is printed with an aqueous ink and thereafter the printed substrate is exposed to microwave radiation, thereby drying the ink on the sheet.



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 95 30 0916

DOCUMENTS CONSIDERED TO BE RELEVANT			Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages			
X	<p>DATABASE WPI Section Ch, Week 8733, Derwent Publications Ltd., London, GB; Class E19, AN 87-232398 &amp; JP-A-62 156 984 (CANON KK) 11 July 1987 * abstract *</p>	1,2,5-9	B41M5/00 D21H17/06	
Y	---	10		
X	<p>DATABASE WPI Section Ch, Week 8648, Derwent Publications Ltd., London, GB; Class A82, AN 86-314194 &amp; JP-A-61 230 978 (CANON KK) 15 October 1986 * abstract *</p>	1,3,5,6,9		
X	<p>WO-A-93 01938 (3M) * example 9c *</p>	1-6,9	<p>TECHNICAL FIELDS SEARCHED (Int.Cl.6)</p> <p>B41M D21H</p>	
X	<p>EP-A-0 106 763 (ROQUETTE FRÈRES) * page 5, line 17 - line 20 *</p>	1-8		
P,X	<p>EP-A-0 611 662 (AGFA GEVAERT) * the whole document *</p>	1-8		
Y	<p>US-A-5 220 346 (CARREIRA ET AL.) * claim 1 *</p>	10		
The present search report has been drawn up for all claims				
Place of search THE HAGUE		Date of completion of the search 26 May 1995	Examiner Bernardo Noriega, F	
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p>		<p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>a : member of the same patent family, corresponding document</p>		

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